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Mergers and Partial Ownership

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Abstract: In this paper we compare the profitability of a merger between two firms (one firm fully acquires another) and the profitability of a partial ownership arrangement between the same two firms in which the acquiring firm obtains corporate control over the pricing decisions of the acquired firm. We find that joint profit can be higher in the latter case because it may result in a greater dampening of competition with respect to an outside competitor. We also derive comparative statics on the prices of the acquiring firm, the acquired firm, and the outside firm and use them to explain puzzling features of the pay-TV markets in Norway and Sweden.

Keywords: Media economics, Mergers, Corporate Control, Financial Control

1 Introduction

There is a large literature on the profitability of mergers between firms. In this literature, the acquiring firm is assumed to have control over both the pricing and the output decisions of the acquired firm (corporate control). There is also a large literature on the profitability of partial ownership arrangements. In this literature, it is typically assumed that the acquiring firm does *not* obtain corporate control.[1] Not surprisingly, the two literatures have, for the most part, developed independently.

However, as emphasized by O'Brien and Salop (2000), an acquiring firm may achieve corporate control without having obtained a 100% ownership stake. They show that when an acquiring firm has control over the acquired firm's pricing decision, but less than a 100% ownership stake, the welfare effects can be worse than if the firms had merged. In the extreme, an acquiring firm with corporate control might decide not to sell the acquired firm's product even if joint profit and welfare would be higher if it did.[2] The intuition for this result is that an acquiring firm that has only a small financial interest in the acquired firm achieves the benefits from reduced competition when the latter charges high prices but pays only a fraction of the costs of the reduced profit in the acquired firm. There is thus a free-rider problem because the acquired firm earns less profit than it would earn otherwise.

Missing from O'Brien and Salop's analysis is a discussion of whether such arrangements might arise in equilibrium. The ownership structure is assumed to be exogenous. In this paper, we follow O'Brien and Salop's lead by looking at partial ownership arrangements in which the acquiring firm obtains corporate control in the acquired firm—but we differ in that we endogenize the ownership stake that maximizes the joint profits of the two firms. Moreover, we introduce a third competitor external to the two firms involved in the acquisition.

The introduction of an external competitor is key to our results. If there are only two firms in the market, a merger necessarily maximizes joint profit, as this

[1] Reynolds and Snapp (1986) and Bresnahan and Salop (1986) were the among the first to consider partial ownership arrangements. In models with Cournot competition, they show that the effects of partial ownership depend critically on whether corporate control is transferred to the acquiring firm. See also Flath (1989; 1991), Malueg (1992), Reitman (1994), and Gilo et al (2006).

[2] This is formally shown by Nye (1992) in a model with Cournot competition.

leads to the monopoly outcome. When there is an external competitor, however, the monopoly outcome cannot be obtained. In this case, the joint profit of the acquiring and the acquired firm can actually be higher under a partial ownership arrangement, and the reason is that a partial ownership arrangement can lead to a greater dampening of competition when the firms' choices are strategic complements.

We have in mind a setting in which three firms are each producing a substitute good and simultaneously setting prices, resulting in a differentiated-products Bertrand equilibrium. When firm 1 acquires a controlling stake in firm 2, it has the power to set firm 2's price in addition to its own price. In the case of a merger, firm 1 fully internalizes the substitution between goods 1 and 2 and thus raises both prices relative to the competitive benchmark. Nevertheless, it sets the price of good 2 lower than what it would charge if it only had a partial ownership stake in firm 2. This is because in a partial ownership arrangement, firm 1 does not fully bear the costs of substitution away from good 2 when it increases the price on good 2. Firm 3 anticipates the effect of the ownership structure between firms 1 and 2, which becomes a coordinating signal on prices, and thus keeps its own price higher as well.

The main result of the paper is that, if the impact on the price of firm 3 is decreasing in the percentage of the shares acquired, the joint profit of firms 1 and 2 will be higher in the case of partial ownership compared to a merger. We consider the effect on the firms' joint profit because when the acquiring firm decides the ownership stake that maximizes the sum of its own profit and that of the acquired firm, it can make an offer for the shares in the acquired firm such that the shareholders in both firms are better off. Hence, even if the operating profit in the acquired firm were to fall, the shareholders could be compensated through the offer made by the acquiring firm. Thus, there need not be a free-riding problem, unlike in O'Brien and Salop.

This result depends crucially upon the negative effect on the price of good 2, and therefore on the price of good 3, as the percentage of acquired shares increases. Partial ownership can thus be viewed as a commitment device that can be used to affect the external competitor's pricing behavior. This principle of using the financial and corporate structure of a firm as a commitment device in order to affect rival firms' product-market behavior is quite general, and the model structure relates to the seminal paper on strategic delegation by Fershtman and Judd (1987).[3]

The rest of the paper proceeds as follows. Before presenting the formal model we provide an example from the pay-tv market in Scandinavia. In section 2 we set-up the model and derive preliminary results. We then provide an example in section 3 using a Salop circle model of demand to show that a partial ownership arrangement can be optimal – and indeed is always optimal – in the example. Section 4 concludes.

1.1 The market for pay-TV in Scandinavia - an example

To illustrate the potential impact that partial ownership arrangements can have on prices, consider the markets for pay-TV in Norway and Sweden. Demand and supply conditions in these markets are similar along many dimensions. In both countries, there are two providers that offer pay-TV-subscriptions via satellite (Canal Digital and Viasat), and for the majority of households, the only viable alternative to satellite subscription is the digital terrestrial platform (DTT). Within this platform, there is only one firm in each country (RTV in Norway and Boxer in Sweden).

However, despite these similarities, the price pictures in Norway and Sweden differ markedly, as illustrated in Table 1. First, we see that the subscription fee for RTV is significantly higher than for Boxer (only a small portion of the price difference can be explained by the generally higher price level in Norway compared to Sweden). Second, we see that Canal Digital charges a lower price than its DTT competitor in Norway but a higher price than its DTT competitor in Sweden.[4]

It is not surprising that Canal Digital (and Viasat) has a higher subscription fee than does Sweden's Boxer. Indeed, this is consistent with the widespread view that a large fraction of the customers in Sweden consider the DTT platform as inferior to the satellite platform.[5] But why, then, is RTV more expensive than Canal Digital in Norway? And why is DTT so much more expensive in Norway than in Sweden?

[3] Brander and Lewis (1986) analyze how a firm may choose its financial structure (degree of debt) as a credible commitment to engage in aggressive product-market behavior under Cournot competition. Showalter (1995) analyzes the choice of debt as a commitment device to nonaggressive behavior under entry accommodation and price competition (see Tirole (2006) for an overview).

[4] A similar pattern holds for the prices charged by Viasat relative to RTV and Boxer.

[5] The reason is that DTT faces stricter capacity limits, which reduces the number of channels that may be provided in premium packages (as well as the ability to provide HDTV-quality).

Norway	Price RTV	Relative price CD/RTV
	$ 490	0.62
Sweden	Price Boxer	Relative price CD/Boxer
	$ 210	1.87

Table 1: *Yearly pay-TV prices (subscription fees) in Norway and Sweden.*

We suggest that the difference in ownership structures between the two countries may provide an explanation. Important in this respect is the fact that Boxer is an independently-owned firm, whereas the Norwegian telecommunications incumbent Telenor owns 100% of the shares in Canal Digital and 33.3% of the shares in RTV. Thus, per the discussion above, one can think of Telenor, through its ownership of Canal Digital, as firm 1 (the acquiring firm) and RTV as firm 2 (the acquired firm).

Let us first assume (we think erroneously) that Telenor has no corporate control in RTV, and thus is a passive investor in that company. In this case, one would expect the financial interests in RTV will give Telenor an incentive to raise the price of Canal Digital in Norway relative to Sweden, since some of the profit associated with reduced sales of Canal Digital in Norway will be recaptured through Telenor's stake in RTV. However, this prediction is inconsistent with the above observation, since we then should expect the price for satellite access to be relatively higher than for DTT access in Norway compared to Sweden. Neither can Telenor's partial financial interest in RTV explain why RTV charges a much higher price than Boxer.

The assumption that Telenor is a passive investor in RTV also does not seem likely to hold because the other two shareholders in RTV, NRK and TV2, the largest broadcasters in Norway, have no experience with operating distribution platforms. This suggests that Telenor to a large extent will likely be able to control RTV's competitive decision making, including pricing decisions. At the outset one might think that NRK and TV2 would be unwilling to let Telenor have corporate control, since Telenor also owns the competitor Canal Digital. However, as we show below—

and this is another main point of our analysis—it is precisely in such a situation that it might be suboptimal for NRK and TV2 to fight for corporate control.

Suppose, therefore, that Telenor has corporate control in RTV as well as in Canal Digital. Then Telenor will have an incentive to increase RTV's price in order to reduce the competitive pressure on Canal Digital. If Telenor owned 100% of the shares in both companies, Telenor would induce RTV and Canal Digital to set the same (high) prices, other things being equal. However, since Telenor only has 33% of the shares in RTV, it will have incentives to set a higher price for the services offered by RTV than for the services offered by Canal Digital in Norway (c.f Proposition 2 below). This might be true even if consumption of the former has a lower perceived quality. Our model can therefore shed some light on the price patterns in Table 1.

By its very nature, we cannot directly compare the actual outcome in Scandinavia with a counterfactual case where Telenor has a larger partial financial interest in RTV. However, the digital terrestrial platform was established in 2007, and prior to this the analogue terrestrial platform was the only alternative to direct-to-home satellite access for the majority of households. The analogue terrestrial platform in Norway was owned by Telenor. Hence, when this platform was replaced with the digital terrestrial platform, Telenor's financial stake in the only alternative to the satellite platform was significantly reduced. Consistent with our model, the data reveals that subsequent to the introduction of the DTT platform in Norway, Canal Digital reduced its prices, and has become relatively more aggressive than Viasat.[6]

2 The model and preliminary results

There are three firms in the market. Each produces an imperfect substitute. We focus on a setting in which one firm acquires an ownership stake in a rival. Without

[6] The case at hand also has similarities with the BSkyB/ITV merger case in the UK. In 2006, the largest pay-TV provider, BSkyB, announced that it had acquired 17.9 per cent of shares in ITV. The UK Competition Commission (2007) concluded that at this level of ownership stake, the transaction would give BSkyB a significant degree of corporate control in ITV. The Commission's view was that BSkyB would have an incentive and ability to weaken the competitive constraint ITV had on BSkyB. The Commission felt that BSkyB's shareholding in ITV should be reduced below 7.5%, since this would then restrict the BSkyB's ability to have corporate control in ITV.

loss of generality, let firm 1 be the acquiring firm, firm 2 be the acquisition target, and firm 3 be the outside firm, whose response to the acquisition will be crucial.

To focus on the effects of market power in this market, we assume there are no realized cost savings as a result of the acquisition. We also assume that firms compete by simultaneously choosing prices. Let $\Pi_i(\mathbf{p})$ denote firm i's profit as a function of the vector of prices, $\mathbf{p}$, where $\mathbf{p} = (p_1, p_2, p_3)$, and p_i denotes firm i's price. Let $\beta \leq 1$ denote the ownership stake in firm 2 that is acquired by firm 1.

We now make the following assumption:

Assumption 1: *For any acquisition, there exists $\underline{\beta} > 0$ such that for all $\beta \in [\underline{\beta}, 1]$, firm 1 will obtain corporate control over firm 2, meaning that it will control not only its own pricing decision but also the pricing decision for good 2.*

We allow for a wide range of $\underline{\beta}$ in what follows. In practice, firm 1 would clearly have corporate control if $\beta > 1/2$. But, in some cases, it might also have corporate control even if $\beta \leq 1/2$, as we suggest may be the case in the pay-TV market in Norway (see also the UK Competition Commission's views in footnote 6). For β sufficiently small, however, assuming corporate control is likely to be unrealistic.

The game is played in two stages. At stage 1, firm 1 decides on what ownership share β to acquire, and at stage 2, assuming firm 1 has chosen $\beta \geq \underline{\beta}$, firm 1 decides on p_1 and p_2, and firm 3 decides on p_3. The solution in stage 2 is thus given by

$$\{p_1, p_2\} \;=\; \arg\max \;\; \Pi_1(p) \;+\; \beta\Pi_2(p), \tag{1}$$

$$p_3 \;=\; \arg\max \;\; \Pi_3(p). \tag{2}$$

We assume that profits are continuous and differentiable, and that all second-order conditions are satisfied. We further make the standard assumption that own-pricing effects dominate cross-pricing effects, and that pricing decisions are strategic complements (a la Bulow et al, 1985), i.e., that reaction functions are upward sloping.[7]

With these assumptions, we obtain the following comparative-static result.

[7] More formally, let $\Omega_{12}(p,\beta) \equiv \Pi_1(p) + \beta\Pi_2(p)$. Then, for all $\beta \leq 1$ and $i, j = 1, 2$, $i \neq j$, we assume $\partial^2\Omega_{12}/\partial p_1^2 < 0$, $\partial^2\Omega_{12}/\partial p_i \partial p_j > 0$, $\partial^2\Omega_{12}/\partial p_2^2 < 0$, $\partial^2\Pi_3/\partial p_3^2 < 0$, and $\partial^2\Pi_3/\partial p_3 \partial p_i > 0$.

Proposition 1 *Suppose goods 1 and 2 are symmetrically differentiated and have identical costs of production. Fix firm 3's price at* p_3*. For* β *sufficiently close to zero, firm 1 will optimally set* p_2 *such that* $q_2 = 0$*. For* β *sufficiently close to one, firm 1's will optimally set* p_1*,* p_2 *such that* q_1*,* $q_2 > 0$*, with* $dp_1/d\beta > 0$ *and* $dp_2/d\beta < 0$*.*

Proof: See the appendix.

Proposition 1 offers insight into how firm 1's profit-maximizing prices will vary as a function of β. Intuitively, since the goods are substitutes, demand for good 1 is decreasing in output of good 2 (and vice versa). If firm 1 owns a very small share of firm 2, it will thus find it optimal to maximize the profitability of good 1 by not selling good 2 at all (see also Nye, 1992, and O'Brien and Salop, 2000); $q_2 = 0$. However, this does not maximize aggregate profits $\Pi_1 + \Pi_2$ if the two goods are imperfect substitutes. Firm 1 will therefore optimally reduce the price of good 2 to ensure that $q_2 > 0$ if it owns a sufficiently large share of firm 2. This explains why $dp_2/d\beta < 0$, as it will put more weight on Π_2 the higher is β. Or, to phrase it differently, the higher is firm 1's share of ownership in firm 2, the more firm 1 internalizes the negative effects on firm 2's profit of setting an artificially high p_2. Since Π_2 is increasing in p_1, it further follows that, other things being equal, firm 1 should set a higher price on good 1 the more it owns of firm 2, i.e., $dp_1/d\beta > 0$.[8]

The net implication of these findings is that by acquiring less than 100% of firm 2, firm 1 can credibly commit to setting a higher p_2 than what would maximize firm 1 and 2's joint profit for any given p_3. Whether, and under what circumstances, this will induce less aggressive behavior from firm 3 is the main question we address.

2.1 The trade-off of partial ownership

A trade-off arises if the commitment to a higher p_2 (that is brought about by the partial ownership arrangement) would induce less aggressive behavior on the part

[8] For completeness, it should be noted that p_1 need not be monotonically increasing in β. To see why, consider the critical value of β, $\beta \equiv \beta^0$, at which it becomes optimal for firm 1 to sell a positive quantity of good 2. The fact that the goods are substitutes then implies that demand for good 1 falls. This will in general induce firm 1 to reduce the price on good 1. We should therefore expect p_1 to be a U-shaped function of β, with $dp_1/d\beta|_{\beta=\beta^0} < 0$ and $dp_1/d\beta|_{\beta=1} > 0$.

of firm 3. On the one hand, the favorable response by firm 3 would benefit firms 1 and 2. On the other hand, the higher p_2 by definition is an upward distortion from that which would maximize the joint profit of firms 1 and 2 all else being equal.

To capture the essence of this trade-off, we now allow p_3 to vary and let $p_1^*(\beta)$, $p_2^*(\beta)$, and $p_3^*(\beta)$ denote the equilibrium prices as a function of β. We want to know whether the maximization of firm 1 and 2's profit occurs at $\beta = 1$, as is implicitly assumed in the merger literature, or whether it occurs at some $\beta < 1$. Thus, consider

$$\max_{\beta} \quad \Pi_1(p_1^*(\beta), p_2^*(\beta), p_3^*(\beta)) + \Pi_2(p_1^*(\beta), p_2^*(\beta), p_3^*(\beta)),$$

which yields the following first-order condition

$$\left(\frac{\partial \Pi_1}{\partial p_1} + \frac{\partial \Pi_2}{\partial p_1}\right)\frac{dp_1^*}{d\beta} + \left(\frac{\partial \Pi_1}{\partial p_2} + \frac{\partial \Pi_2}{\partial p_2}\right)\frac{dp_2^*}{d\beta} + \left(\frac{\partial \Pi_1}{\partial p_3} + \frac{\partial \Pi_2}{\partial p_3}\right)\frac{dp_3^*}{d\beta}. \tag{3}$$

Substituting the first-order conditions from the pricing game, (3) reduces to

$$(1-\beta)\left(\frac{\partial \Pi_2}{\partial p_1}\frac{dp_1^*}{d\beta} + \frac{\partial \Pi_2}{\partial p_2}\frac{dp_2^*}{d\beta}\right) + \left(\frac{\partial \Pi_1}{\partial p_3} + \frac{\partial \Pi_2}{\partial p_3}\right)\frac{dp_3^*}{d\beta}. \tag{4}$$

Suppose for the moment that firm 3's price is independent of β, so that $\frac{dp_3^*}{d\beta} = 0$ for all $\beta \leq 1$. Then, it follows immediately from (4) that $\beta = 1$ is a local maximum. And, indeed, it is also a global maximum, as firm 1 obviously cannot do any better than to acquire all of firm 2 in this case. Thus, if a partial ownership arrangement is to increase the joint profit of firms 1 and 2 compared to a merger, it must be because the arrangement induces a favorable response by the outside firm, firm 3.

A favorable response occurs if firm 3's price is decreasing in firm 1's ownership share of firm 2 when evaluated at $\beta = 1$. Or, in other words, a favorable response occurs if firm 1's acquisition of the last bit of firm 2 would cause firm 3 to respond by reducing its price. In this case, it cannot be profitable for firm 1 to acquire all of firm 2 (formally, the first-order condition in (4) would be negative when evaluated at $\beta = 1$ if $\frac{dp_3^*}{d\beta}|_{\beta=1} < 0$). Note further that even if $\frac{dp_3^*}{d\beta} = 0$ at $\beta = 1$, so that $\beta = 1$ is a local maximum, it need not be a global maximum.[9] We have the following result:

[9] This is the case, for example, for the Hotelling demands that we consider in the next section.

Proposition 2 *A sufficient condition for a partial-ownership arrangement to be more profitable than a merger is that* $\frac{dp_3^*}{d\beta}|_{\beta=1} < 0$. *A necessary condition for such an arrangement to be more profitable than a merger is that* $\frac{dp_3^*}{d\beta} < 0$ *for some* $\beta \leq 1$.

Proposition 2 contains the main result of the paper. It gives necessary and sufficient conditions for the joint profit of firms 1 and 2 to be higher under a partial-ownership arrangement than under a merger. Partial-ownership arrangements can be viewed as a commitment device to affect the outside firm's pricing behavior. From the related literature on strategic delegation (see, e.g., Fershtman and Judd, 1987, and Bonanno and Vickers, 1988), it is well known that the outcome of this commitment depends crucially on whether the firms' choices are strategic complements or substitutes. When they are strategic complements, any commitment to become less aggressive (here a partial acquisition, instead of a merger) helps the firms coordinate towards a more collusive outcome. If the firms' choices are instead strategic substitutes (e.g., the firms compete in quantities and have downward-sloping reaction functions), it is straightforward to show that absent significant cost savings, a partial-ownership arrangement would not be profitable in a market with three firms.[10]

Similar necessary and sufficient conditions would arise if firm 1, instead of choosing β to maximize its joint profit with firm 2, were to choose β to maximize the profit that it could expect to earn in stage 2, $\Pi_1 + \beta\Pi_2$. Although the first multiplicative term in equation (4) would then be zero, the second term would be unchanged, and thus so would the sufficiency condition in Proposition 2. In this and the previous case, knowing how firm 1's acquisition of shares in firm 2 affects firm 3's price at the margin is the key to determining which ownership structure is more profitable.

In what follows, we assume that firm 1 solves for the ownership share β^* that would maximize the joint profit of firms 1 and 2 in stage 2. The reason is that in practice, firm 1 will have to buy its shares before the stage 2 game is actually played. One way to do this is to offer to buy β^* of the shares from each of firm 2's owners.

[10]Relatedly, Salant et al. (1983) were the first to show that a merger between two firms would also not be profitable in this setting when quantities are strategic substitutes. The reason is that the merger would cause the third firm to expand its output to the detriment of the merging firms.

By choosing the ownership share that maximizes joint profit, firm 1 is thus assured of being able to make a profitable offer that all of firm 2's owners would accept.[11]

Since we would normally expect firm 1's price to be increasing in its ownership share of firm 2, and conversely, firm 2's price to be decreasing as firm 1 owns more of firm 2, we need to use a more specified model of demand to determine the net effect on firm 3's price of an increase in β. This is the subject of the next section, where we show that in a model of demand in which consumers are located around a unit circle, the effect of the increase in firm 2's price outweighs the effect of the decrease in firm 1's price, such that firm 1 never wants to fully merge with firm 2.

3 Salop circle model of demand

We consider a circular city model a-la Salop (1979) with a uniform distribution of consumers, a perimeter of 1, and a unitary density of consumers around the circle.[12] The firms are located equidistantly from each other, and for simplicity all marginal and fixed costs are set to zero. Throughout we restrict our analysis to outcomes with full market coverage (all consumers buy from one of the firms) and in which all three firms are active in the market. We assume quadratic transportation costs such that the location of a consumer who is indifferent between buying from firm i and j is given by $tx^2 + p_i = t\left(\frac{1}{3} - x\right)^2 - p_j$.[13] This yields the following demands:

$$q_i(p) = \frac{1}{3} - 3\frac{2p_i - (p_j + p_k)}{2t}, \tag{5}$$

[11] This allocation procedure is consistent with U.S. regulations for acquisitions. A takeover process usually starts with a tender offer (an invitation to buy a part or all of the shares of a firm at an announced price). The offer may be conditional on a given number of shares being tendered, such that the bidder may obtain corporate control. According to U.S. regulations, a bidder that provides an offer to buy less than 100% of the shares of a firm must accept shares tendered on a pro-rated basis (see e.g., Hunt, 2009, page 524). As an example, consider a partial-ownership structure in which one firm offers to buy 30% of the shares of another firm. If all shareholders accept the offer, the bidder is obligated under the law to buy 30% of all the shareholders' stocks.

[12] The Hotelling and Salop frameworks have become the standard tools for analyzing media economics, see e.g. Anderson and Coate (2005), Gabszewicz et al (2004) and Peitz and Valletti (2008). One reason for this is that unitary demand seems reasonable in the media industry (people watch either zero or one TV channel at any given time, or choose either cable or satellite, etc).

[13] In this section linear transportation costs would yield the same outcome. Nevertheless, we use quadratic transportation costs because, in section 3.2, we also consider asymmetric locations.

where $i, j, k = 1, 2, 3$, $i \neq j \neq k$, and $p = (p_1, p_2, p_3)$ is the vector of prices.

Given that firm 1 has corporate control over firm 2 (c.f. Assumption 1), the solution to the last stage of the game is given by

$$\{p_1, p_2\} = \arg\max \; \underbrace{p_1 q_1(p)}_{\pi_1} + \beta \underbrace{p_2 q_2(p)}_{\pi_2}, \tag{6}$$

$$p_3 = \arg\max \; p_3 q_3(p). \tag{7}$$

Solving the first-order conditions from (6) and (7) yield the stage 2 reaction functions

$$\begin{aligned} p_1 &= \frac{t}{18} + (1+\beta)\frac{p_2}{4} + \frac{p_3}{4}, \\ p_2 &= \frac{t}{18} + \left(\frac{1+\beta}{\beta}\right)\frac{p_1}{4} + \frac{p_3}{4}, \\ p_3 &= \frac{t}{18} + \frac{p_1 + p_2}{4}, \end{aligned}$$

from which it follows that $\partial p_1/\partial\beta = p_2/4 > 0$ and $\partial p_2/\partial\beta = -p_1/\left(4\beta^2\right) < 0$. The price charged by firm 3 depends on β indirectly, through the rivals' prices p_1 and p_2.

Solving the three reaction functions simultaneously yields equilibrium prices

$$p_1^* = \frac{10\beta\,(5+\beta)\,t}{9D}, \quad p_2^* = \frac{10(1+5\beta)t}{9D}, \quad \text{and} \quad p_3^* = \frac{16\beta t}{3D}, \tag{8}$$

where $D = 36\beta - 5(1-\beta)^2$ is strictly positive in the relevant area (see below).

If firms 1 and 2 merge, firm 1 will fully internalize the fact that a higher price on good 1 increases demand for good 2, and vice versa. In this case, it follows from (8) that $p_1^* = p_2^* = 5t/27 > p_3^* = 4t/27$. However, if firm 1 does not purchase all of firm 2's shares, its incentive will be to increase the price of good 2 above $5t/27$ in order to earn a higher profit on good 1. By acquiring less than 100% of firm 2, firm 1 thus gives a credible signal to firm 3 that it will charge a higher price on good 2. This tends to increase firm 3's price, such that both $dp_2^*/d\beta < 0$ and $dp_3^*/d\beta < 0$.

The effect on firm 1's price, however, is ambiguous. On the one hand, the strategic complementarity among prices suggests that firm 1's price will also be decreasing in β. On the other hand, all else being equal, firm 1 is more inclined to set a higher price on good 1 to boost demand for good 2 the larger is its financial interests in firm 2 (c.f. Proposition 1). This effect goes in the opposite direction of strategic complementarity. On net, the equilibrium prices in (8) suggest that $dp_1^*/d\beta > 0$ if and only if $\beta > 0.66$.

Substituting the prices in (8) into (5) yields $q_2(p) = 5\,(3\beta - 1)\,/D$. If β is sufficiently small, firm 1's incentive is to set p_2 such that firm 2 will face no demand (see footnote 7). Hence, to ensure that $q_2(p) \geq 0$ (and also that $D > 0$), we assume

$$\beta \geq \frac{1}{3}.$$

With this assumption, equilibrium profits for the three firms are given by

$$\pi_2^* = \frac{50t\,(1+5\beta)\,(3\beta-1)}{9D^2}, \tag{9}$$

$$\pi_1^* = \frac{50t\,(3-\beta)\,(5+\beta)\,\beta^2}{9D^2}, \quad \text{and} \quad \pi_3^* = \frac{256t\beta^2}{3D^2}, \tag{10}$$

where π_i^* denotes firm i's equilibrium profit. It is straightforward to show from (9) that π_2^* is increasing in β, while π_1^* and π_3^* are decreasing in β.

The fact that $d\pi_3/d\beta < 0$ raises the question of whether firm 3 would want to oppose firm 1's acquisition of shares in firm 2, i.e. whether π_3 is highest for $\beta = 0$. The answer is no; it can be shown that if all firms are independent, each will make profits equal to $\pi_i = t/27$. Using equation (10), we then find that $\pi_3^* - \pi_i > 0$ in the relevant area.[14] It is thus profitable for firm 3 that firm 1 acquires corporate control over firm 2, but it would like the share acquisition to be as small as possible. The intuition is simply that the smaller is β, the lower will be the aggregate output from firms 1 and 2 (and with $q_2 = 0$ for sufficiently low values of β, c.f. Proposition 1).

At stage 1, firm 1 chooses how much of firm 2 to acquire in order to maximize its joint profit with firm 2 given the anticipated equilibrium stage 2 prices. Summing π_1^* and π_2^* we have

$$\pi_1^* + \pi_2^* \;=\; \frac{25t}{81}\left\{1 + (1-\beta)^2 \frac{[36\beta - 79(1-\beta)^2]}{D^2}\right\}. \tag{11}$$

[14] Calculations show that $\pi_3^* - \pi_i = t\left(2\beta + 5\beta^2 + 5\right)\left(94\beta - 5\beta^2 - 5\right)/(27D^2) > 0$ for $\beta > 0.05$, and thus also in the relevant area $\beta \in [1/3, 1]$

It follows immediately that partial ownership of firm 2 is more profitable for firms 1 and 2 than full ownership as long as $36\beta > 79(1-\beta)^2$, i.e. as long as $\beta > \widetilde{\beta} \approx 0.52$. Solving for the acquisition share that maximizes the two firms' joint profit yields[15]

$$\beta^* \;=\; 1 - \frac{6\sqrt{2}-2}{17} \;\approx\; 0.619. \tag{12}$$

Proposition 3 *A partial-ownership arrangement is more profitable for firms 1 and 2 than a merger for all $\beta \in [\widetilde{\beta}, 1)$. Their joint profit is maximized at $\beta = \beta^*$.*

The key to this result is the effect an increase in ownership has on the price of firm 3's product. Since $dp_3^*/d\beta < 0$, it follows that relative to the case of a merger between firms 1 and 2, firm 3's price will be higher when firm 1 does not own all of firm 2 but nevertheless has corporate control. A higher price on firm 3's product benefits firms 1 and 2, and this benefit is enough to more than offset the gain firms 1 and 2 could have achieved by merging and thereby fully coordinating their prices.

Substituting the joint-profit maximizing ownership share, $\beta = \beta^*$, into the equilibrium prices in (8) yields the following comparative-static result on firm prices:

Proposition 4 *At the optimal ownership share $\beta = \beta^*$, firm 1 sets a lower price on good 1 and a higher price on good 2, and firm 3 sets a higher price on good 3, relative to the prices that would have arisen had firms 1 and 2 merged instead.*

The results in this section have some important implications for competition policy, namely that a partial-ownership arrangement in which $\beta = \beta^* < 1$ makes consumers in aggregate worse off than they would have been if the firms had merged. The reason for this is that the partial ownership serves as a commitment device to credibly soften competition. Furthermore, within the context of the Salop circle model of demand, there will be also a welfare loss due to the fact that the average transportation costs are higher under a partial-ownership arrangement than under a merger. However, not all consumers are worse off. Consumers that would buy from firm 1 also under a merger would benefit from the partial-ownership arrangement.

[15] See our earlier discussion on why firm 1 chooses β to maximize $\pi_1 + \pi_2$ rather than $\pi_1 + \beta\pi_2$.

3.1 Fight for corporate control

We have shown that it is optimal for firm 1 to stop short of a merger under the assumption that it will still control all pricing decisions (Assumption 1). Therefore, two important questions are: how reasonable is this assumption, and will the owners of the remaining shares have an incentive to try to wrest this control from firm 1?

To investigate these questions, assume that firm 2 at the outset is owned by one shareholder, and that without the acquisition, she would have corporate control in firm 2. She will then accept the offer from firm 1 at stage 1 if the sum of what she is paid at stage 1 for a fraction β^* of the shares in firm 2 and the residual stage 2 operating profit of firm 2, $(1-\beta^*)\pi_2$, is higher than what she would achieve if she does not accept firm 1's offer and firm 2 continues to operate as separate firm. However, after the acquisition is completed, the residual owner of firm 2 will have an incentive to try to recapture corporate control if this increases the firm's stage 2 operating profit. Having such incentives clearly does not necessarily mean that she will succeed, but partial acquisition of firm 2 might be more appealing to firm 1 if the residual owner does not have such incentives. In this subsection, we consider whether and under what conditions firm 1 can expect a subsequent fight for control.

Assume for now that the residual owners are able to wrest corporate control of firm 2's pricing decision. Then the stage 2 maximization problems are as follows:

$$\begin{aligned}
\max_{p_1} &= p_1 q_1(p) + \beta p_2 q_2(p), \\
\max_{p_2} &= (1-\beta)\, p_2 q_2(p), \\
\max_{p_3} &= p_3 q_3(p).
\end{aligned}$$

Solving for the equilibrium prices yields

$$p_1 = \frac{2t(5+\beta)}{9(10-\beta)} \geq p_2 = p_3 = \frac{10t}{9\,(10-\beta)}.$$

Substituting these prices into the total operating profit from selling good 2 yields

$$\tilde{\pi}_2 = \frac{100t}{27\,(10-\beta)^2}. \tag{13}$$

The operating profit of firm 2 when firm 1 has corporate control is given by (9). Comparing the operating profit of firm 2 with and without the transfer of corporate control to firm 1 yields the following result.

Proposition 5 *The non-firm 1 owners have no incentive to fight ex-post for the corporate control of the pricing decision on good 2 if* $\beta \in [\widehat{\beta}, 1)$*, where* $\widehat{\beta} \approx 0.623$.

This result is illustrated in Figure 1 below, where the broken line shows the value of firm 2 when firm 1 has corporate control (given by (9)) and the solid line shows the value of firm 2 when firm 1 does not have corporate control (given by (13)). The residual owners of firm 2, i.e., those that control $1-\beta$ of the shares in firm 2, have no incentive to wrest corporate control over firm 2 from firm 1 if $\beta \geq \widehat{\beta}$. The residual owners of firm 2 have an incentive (but no ability) to wrest corporate control over firm 2 from firm 1 if $1/2 \leq \beta < \widehat{\beta}$. And, finally, the residual owners of firm 2 have an incentive (and possibly the ability) to wrest corporate control over firm 2 from firm 1 if $\beta < 1/2$.[16] In this section we have that $\beta^* > 1/2$, and we expect that the acquiring firm has corporate control even if $\beta^* > \widehat{\beta}$. However, in the next section we allow for asymmetric location of the firms on the Salop-circle. We then show that we may have $\beta^* < 1/2$.

[16] In this case, although the incentive may be there, firm 1 has a majority stake and need usually not worry about having control wrested from it. Note, however, that in presence of non-voting shares, we may have a situation where even a majority stake is not sufficient to have corporate control.

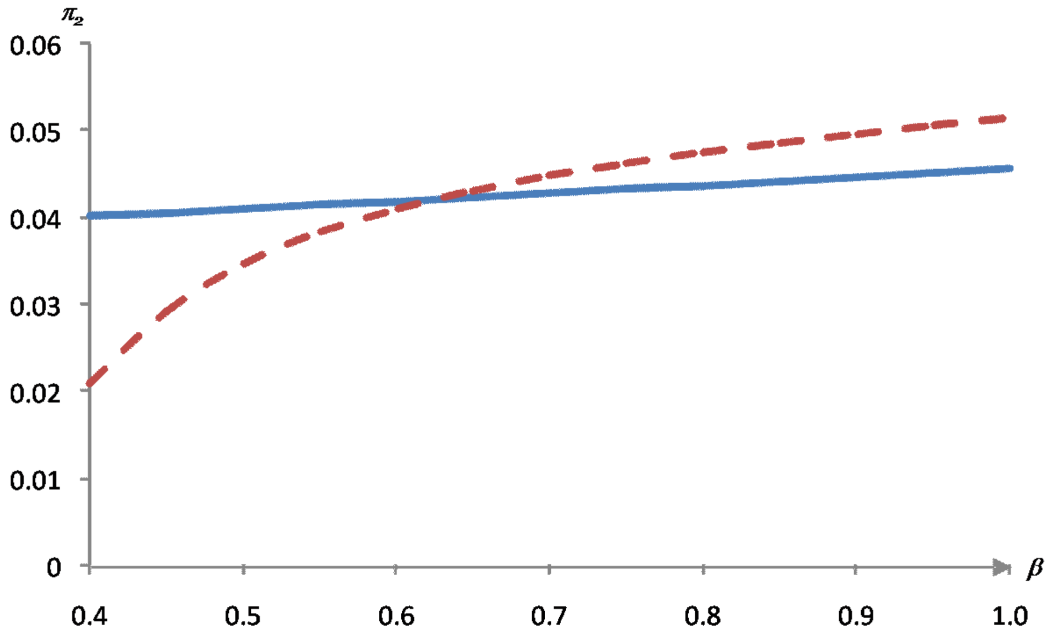

Figure 1: *Firm 1's ownership share and the possibility of a fight for corporate control.*

3.2 Asymmetric location

We have assumed that the firms were symmetrically located along the Salop circle. Suppose instead, as in Figure 2, that the distance between firms 1 and 2 is y, and the distance between firms 2 and 3 and 1 and 3 is $(1-y)/2$. Then, assuming all firms are active and there is complete market coverage, we have for i, $j = 1, 2$, $i \neq j$,

$$q_i(p) = \frac{1+y}{4} - \frac{p_i(1+y) - p_j(1-y) - 2yp_3}{2ty(1-y)} \quad \text{and} \quad q_3(p) = \frac{1-y}{2} - \frac{2p_3 - (p_i + p_j)}{t(1-y)}. \tag{14}$$

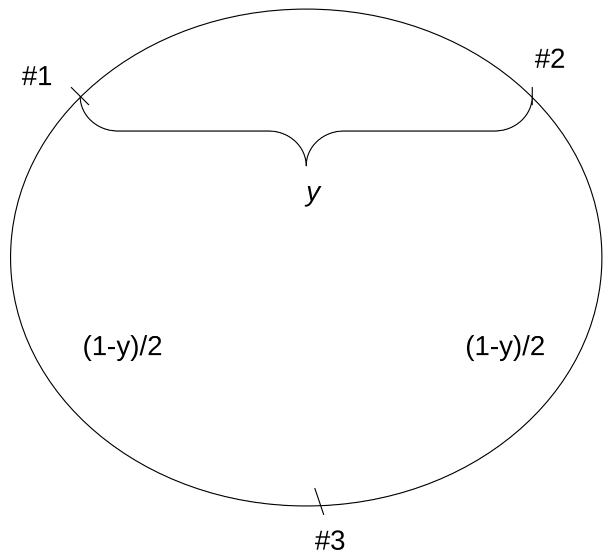

Figure 2: *Asymmetric localization.*

Under the assumption that firm 1 has control over both its own and firm 2's pricing decisions, the stage 2 equilibrium prices are given by

$$p_1 = \frac{\beta\left(4-(1-y)(1-\beta)\right)}{2D_y\left(3+y\right)^{-1}\left(1-y\right)^{-1}}ty, \quad p_2 = \frac{4-(1-\beta)\left(y+3\right)}{2D_y\left(3+y\right)^{-1}\left(1-y\right)^{-1}}ty, \tag{15}$$

and

$$p_3 = \frac{8y\left(3-y\right)\beta-(1-\beta)^2\left(1-3y\right)\left(1-y\right)}{4D_y}t\left(1-y\right), \tag{16}$$

where the denominator D_y is given by $D_y \equiv 24y\beta-(1-\beta)^2\left(1-y\right)\left(2-y\right).$

Using equations (15) and (16), profits for the three firms can be expressed as

$$\pi_1 = \frac{ty\beta^2\left(1+3y-\beta\left(1-y\right)\right)\left(3+y-\beta(1-y)\right)}{4D_y^2\left(3+y\right)^{-2}\left(1-y\right)^{-1}},$$

$$\pi_2 = \frac{\left(\beta(1-3y)-y\right)\left((1-\beta)y-3\beta-1\right)yt}{4D_y^2\left(3+y\right)^{-2}\left(1-y\right)^{-1}},$$

and

$$\pi_3 = \frac{t\left((1-\beta)^2\left(1-3y\right)\left(1-y\right)-8y\beta\left(3-y\right)\right)^2\left(1-y\right)}{8D_y^2}.$$

At stage 1, firm 1 chooses β to solve $\max_\beta\left(\pi_1+\pi_2\right)$, which yields

$$\beta^*(y) = 1 \quad \text{for} \quad y \leq 1/5,$$

$$\beta^*(y) = 1-\frac{4y\left(1-5y\right)+2\sqrt{2y\left(5y-1\right)\left(1+y\right)\left(6-3y^2+y\right)}}{3\left(1-y\right)\left(y^2+5y+2\right)} \quad \text{for} \quad y \geq 1/5.$$

Intuitively, for $y \leq 1/5$, goods 1 and 2 are such close substitutes that firm 1 prefers to merge with firm 2. Otherwise, firm 1 prefers to acquire only a fraction of firm 2, the less so the greater is y. This is illustrated by the solid curve in Figure 3.

If the residual owners of firm 2 acquire corporate control in firm 2, we find that

$$\pi_2 = \frac{(1-y^2)(y+3)^4 yt}{8\left(6+17y-2\beta-3(1-\beta)y+3y^2+(1-\beta)y^2\right)^2}.$$

The dotted curve $\beta^C(y)$ in Figure 3 shows the combinations of y and β where the residual owners of firm 2 are just indifferent to fighting for corporate control. If firm 1's share is less than $\beta^C(y)$, these owners will fight for control, but will otherwise prefer that control rest with firm 1. By choosing $\beta = \beta^C(y)$ for $y > y^{\#} \approx 0.32$ and $\beta = \beta^*(y)$ for $y < y^{\#}$, firm 1 can thus avoid a struggle for corporate control.

We can summarize these results as follows:

Proposition 6 *As long as goods 1 and 2 are sufficiently close substitutes ($y \leq 1/5$), firm 1 prefers to merge with firm 2. Otherwise, for all $y > 1/5$, firm 1 prefers to acquire only a fraction of firm 2 and thus a partial-ownership arrangement is optimal.*

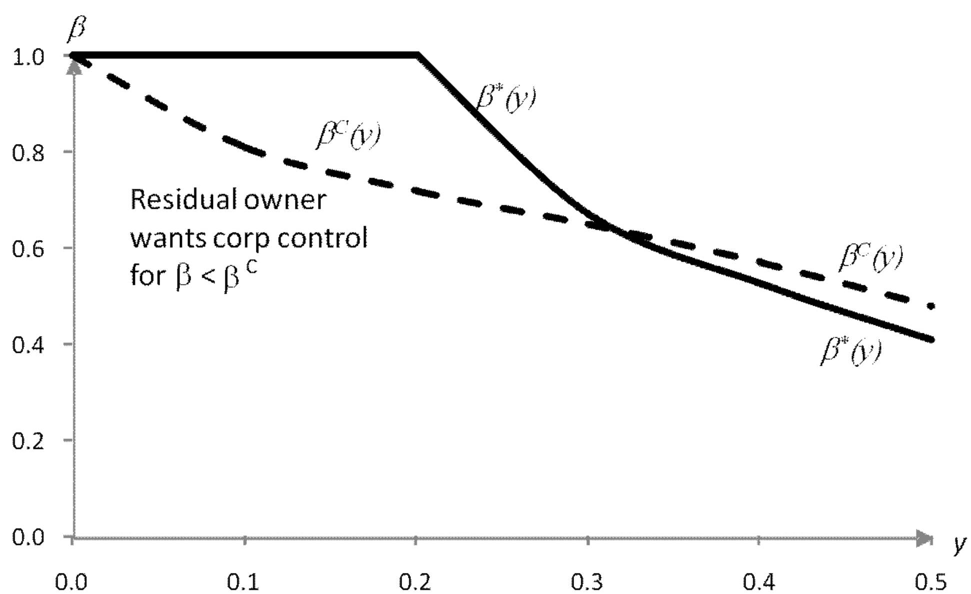

Figure 3: *Asymmetric location; corporate and financial control.*

With symmetric locations, we found that β^* was greater than $1/2$, such that the acquiring firm did not need to worry that the residual owners of firm 2 might try to wrest corporate control. However, the possibility that aggregate profits for firms 1 and 2 are maximized for ownership-shares lower than 1/2 might arise if the firms are asymmetrically located, as is clear from Figure 3. Suppose, for instance, that $y \to 1/2$. We then find that $\beta^* = 0.41$, while $\beta^C = 0.504$. Thus, if the acquiring firm buys only the number of shares that maximizes aggregate profits, β^*, the residual owners of firm 2 will have an incentive to fight for corporate control. To avoid this, the acquiring firm may instead prefer to choose an ownership share greater than β^*.

4 Conclusion

The competitive effects of a merger between two firms are well understood. Two firms that previously were independent are able to coordinate their output and pricing decisions by merging. In the case where the firms produce substitute products, this leads them—in the absence of cost savings—to charge higher prices and/or to cut back on their outputs. It is well known, however, that this effect can be trumped if rival firms in the market are thereby induced to become more aggressive (see Salant et al, 1983). Hence, much of the literature on the profitability of mergers turns on whether the merger would induce rival firms to become more or less aggressive.

Our starting point is a situation in which the merger would induce rival firms to become less aggressive. This presumably is a best-case scenario for a merger to be profitable, as the dampening-of-competition effect seemingly works in the merger's favor. Nevertheless, we have shown in this paper that a merger (in the usual sense of acquiring 100% financial interest in a rival) may not be the optimal strategy for the would-be merging firms. Instead, we have shown that the joint profit of the acquiring firm and the acquired firm can be higher if the acquiring firm purchases less than 100% of the shares in the acquired firm. Although this results in pricing and output distortions that disadvantage it relative to the profit a merged firm would earn all else being equal, the distortions can in some cases lead to a further dampening of competition—-which may more than offset the original loss due to the distortions.

We can extend our analysis of partial acquisitions to a dual setting; when would a cross-majority owner have incentives to sell a fraction of the shares in one of the firms he controls to a silent investor who is outside the industry? As we have shown with partial acquisitions, such partial divestitures may be profitable under price competition. Since the joint profit of the firms that are controlled by the cross-majority shareholder increases in this case, the cross-majority shareholder and the silent investor will be better off with than without the partial divestiture. This has implications for competition policy. Consider a case in which two out of three firms in a market are owned by one stakeholder. Should competition authorities intervene if the owner wants to sell say 30% of the shares of one of these firms to a passive investor? Our analysis suggests that this could worsen competition. By the same token, assume that competition authorities would allow a merger between two out of three firms in a market (perhaps due to anticipated efficiency gains). If the acquiring firm wants to buy say 70% of the shares in the acquired firm instead of all the shares, should the competition authorities require it to buy all the shares?

To our knowledge, this paper is the first to look at the profitability of partial-ownership arrangements when the acquiring firm obtains corporate control. There is no doubt much scope for future work. Because general results are difficult to obtain with differentiated products, one avenue for future research is to assess whether and to what extent the results presented here may hold in other demand contexts (e.g., in models with vertical as well as horizontal product differentiation). It may also be fruitful to look at the effects of agency relationships, in which the acquiring firm hires an agent to carry out its instructions. In these settings, one could then relax the assumption that corporate control is an all or nothing proposition. One might expect the optimal contract in this case (assuming it is publicly observed) to incentivize the agent to give fractional weights to the interests of both the acquiring and the acquired firm when setting prices, which can lead to a much richer analysis.

5 Appendix

Proof of Proposition 1: Given p_3, let (p_1^0, p_2^0) denote firm 1's price pair which maximizes $\Pi_1+\beta\Pi_2$ subject to $q_2 = 0$, i.e. firm 1's optimal price on good 1 given that it sets p_2 such that $q_2 = 0$. If firm 1 marginally reduces the price of good 2 from p_2^0, it will loose $\partial\Pi_1\left(p_1^0, p_2^0\right)/(-\partial p_2)$ in profits from good 1 and gain $\beta\Pi_2\left(p_1^0, p_2^0\right)/(-\partial p_2)$ in profits from firm 2. If $\partial\Pi_1\left(p_1^0, p^0\right)/(-\partial p_2) + \beta\Pi_2\left(p_1^0, p_2^0\right)/(-\partial p_2) < 0$, it will not be optimal to set $p_2 < p_2^0$. This implicitly defines a critical value $\beta \equiv \beta^0 \geq 0$ such that $(p_1, p_2) = (p_1^0, p_2^0)$ is a profit maximizing price pair if $\beta \leq \beta^0$.

If $\beta > \beta^0$, the profit-maximizing p_1 and p_2 are given by the simultaneous solution to the first-order conditions

$$\frac{\partial\Pi_1}{\partial p_1} + \beta\frac{\partial\Pi_2}{\partial p_1} = 0, \tag{17}$$

$$\frac{\partial\Pi_1}{\partial p_2} + \beta\frac{\partial\Pi_2}{\partial p_2} = 0. \tag{18}$$

Totally differentiating this yields

$$\begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix}\begin{pmatrix} dp_1 \\ dp_2 \end{pmatrix} = \begin{pmatrix} -\frac{\partial\Pi_2}{\partial p_1} \\ -\frac{\partial\Pi_2}{\partial p_2} \end{pmatrix} d\beta,$$

where

$$Z_{11} = \frac{\partial^2\Pi_1}{\partial p_1^2} + \beta\frac{\partial^2\Pi_2}{\partial p_1^2}, \quad Z_{12} = \frac{\partial^2\Pi_1}{\partial p_1\partial p_2} + \beta\frac{\partial^2\Pi_2}{\partial p_1\partial p_2},$$
$$Z_{21} = \frac{\partial^2\Pi_1}{\partial p_2\partial p_1} + \beta\frac{\partial^2\Pi_2}{\partial p_2\partial p_1}, \quad Z_{22} = \frac{\partial^2\Pi_1}{\partial p_2^2} + \beta\frac{\partial^2\Pi_2}{\partial p_2^2}.$$

This yields

$$\frac{dp_1}{d\beta} = \frac{-\frac{\partial\Pi_2}{\partial p_1}Z_{22} + \frac{\partial\Pi_2}{\partial p_2}Z_{12}}{Z_{11}Z_{22} - Z_{12}Z_{21}}, \quad \frac{dp_2}{d\beta} = \frac{-\frac{\partial\Pi_2}{\partial p_2}Z_{11} + \frac{\partial\Pi_2}{\partial p_1}Z_{21}}{Z_{11}Z_{22} - Z_{12}Z_{21}}.$$

Our assumptions imply $Z_{ii} < 0$, $Z_{ij} > 0$, and $|Z_{ii}| > Z_{ij}$, and since $\frac{\partial\Pi_2}{\partial p_2} = -\frac{\partial\Pi_2}{\partial p_1}$ under symmetry when $\beta = 1$, it follows that $\frac{dp_1}{d\beta} > 0$ and $\frac{dp_2}{d\beta} < 0$ as in the Proposition.

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